

Notice of Allowability

Application No.

10/570,586

Examiner

WILLIAM C. CHOI

Applicant(s)

FILHOL ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to interview conducted 3/21/08.
2. ☒ The allowed claim(s) is/are 1-63.
3. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☒ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
- * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|--|--|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input checked="" type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date <u>20080320</u> . |
| 3. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date <u>080306</u> | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____. |

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Khaled Shami on March 21, 2008.

The application has been amended as follows:

1. In claim 1, line 7, delete "characterised" and insert therein --characterized--.
2. In claim 1, line 2, delete "part" and insert therein --part,--.
3. In claim 1, line 17, delete ". The" and insert therein --, the--.
4. In claim 1, line 9, delete "actuators" and insert therein --actuators,--.
5. In claim 3, line 2, delete, "centre" and insert therein --center--.
6. In claim 4, line 2, delete "part" and insert therein --part,--.
7. In claim 5, line 2, delete "part" and insert therein --part,--.
8. In claim 23, line 11, delete "." and insert therein --,--.
9. In claim 32, line 2, delete "zone" and insert therein --zone,--.
10. In claim 32, line 2, delete "fixed part" and insert therein --fixed part,--.
11. In claim 32, line 6, delete "wherein means" and insert therein --wherein the means--.
12. In claim 32, line 7, delete "actuators" and insert therein --actuators,--.
13. In claim 32, line 16, delete "occurring" and insert therein --occurring--.

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14. In claim 34, line 2, delete "centre" and insert therein --center--.
15. In claim 35, line 2, delete "part" and insert therein --part,--.
16. In claim 36, line 2, delete "part" and insert therein --part,--.
17. In claims 1-21, 23-52 and 54-63, delete all reference numerals and letters corresponding to Figures included in parentheses. (See attached "Clean version of claims").

AMENDED CLAIMS (Clean Version)

1. Micro-mirror made up of a moving part, with a reflective zone, a fixed part, a means of connection of the moving part to the fixed part, forming an axis of rotation contained in the moving part substantially parallel to a principal plane of the moving part and means of electrical control of the rotation of the moving part about the axis, characterized by the fact that the means of electrical control include two or more actuators, each formed of a fixed electrode which forms part of the fixed part and a moving electrode possessing a free end and an end which is connected to a drive arm which is substantially parallel to the axis and emerging from the moving part, with the moving electrode being designed to adhere to the fixed electrode from its free end when an actuation voltage is applied between the two electrodes of one of the actuators, the adhesion occurs over a surface which varies as a function of the voltage applied between the electrodes of the actuator, with the actuators being arranged on either side of the axis.
2. Micro-mirror according to claim 1, wherein the means of connection of the moving part to the fixed part are two torsion arms emerging from the moving part whose ends are connected to the fixed part.
3. Micro-mirror according to claim 1, wherein the axis passes through the geometric center of the moving part.
4. Micro-mirror according to claim 2, wherein, on the same side of the moving part, a drive arm is offset in relation to a torsion arm.

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5. Micro-mirror according to claim 2, wherein, on the same side of the moving part, a drive arm and a torsion arm are an extension of each other.
6. Micro-mirror according to claim 5, wherein the torsion arm has a transverse section that is less than that of the drive arm.
7. Micro-mirror according to claim 5, wherein the torsion arm has a transverse section that is substantially equal to that of the drive arm.
8. Micro-mirror according to claim 1, wherein several moving electrodes are linked to the same drive arm.
9. Micro-mirror according to claim 1, wherein each drive arm is integral with a single moving electrode.
10. Micro-mirror according to claim 1, wherein several moving electrodes located on the same side of the axis are linked together at their free end.
11. Micro-mirror according to claim 1, wherein at least one moving electrode is wound on itself, with its free end located in a central area of the winding.
12. Micro-mirror according to claim 1, wherein at least one moving electrode is substantially rectilinear.
13. Micro-mirror according to claim 1, wherein at least one moving electrode includes a body of substantially constant width extending by means of a stub at its free end, the width of the stub being greater than that of the body.
14. Micro-mirror according to claim 1, wherein the fixed electrodes of the actuators are combined.
15. Micro-mirror according to claim 1, wherein the fixed part includes a base and

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columns on which rest the means of connection, with the moving part being suspended above the base.

16. Micro-mirror according to claim 15, wherein the base includes a cavity opposite the moving part which is suspended above the cavity.

17. Micro-mirror according to claim 1, wherein the fixed electrodes are covered with a dielectric material.

18. Micro-mirror according to claim 1, wherein the means of electrical control include an addressing device capable of applying an actuation voltage to the moving electrodes and/or the fixed electrodes.

19. Micro-mirror according to claim 18, wherein the actuation voltage is a continuous voltage added to a variable control voltage.

20. Micro-mirror according to claim 18, wherein at least one fixed electrode of an actuator is divided into two portions one of which is an end portion, with these two portions being insulated from each other, with the addressing device being capable of applying a continuous voltage to the end portion and a variable control voltage to the other portion.

21. Micro-mirror according to claim 19, wherein the continuous voltage is a minimal voltage for maintaining adhesion of the free end of the moving electrode of the actuator onto the fixed electrode.

22. Micro-mirror according to claim 19, wherein when the control voltage applied to an actuator located on one side of the axis is non-zero, the control voltage applied at the same time to an actuator located on the other side of the axis is zero.

23. Process for the manufacture of a micro-mirror according to claim 1, wherein it includes the following steps:

a) etching of the outline of a first region of the moving part, of a first region of the fixed part, a first region of the drive arms and of a first region of the means of connection in a surface layer and a first insulating layer of a stratified substrate made up of an alternating stacking of a first and second layer of insulating material and two semi-conductive layers one of which is intermediate and the other of which is a surface layer,

b) in a second semi-conductive substrate the etching of a recessed part, with this second substrate contributing to the formation of a second region of the fixed part and the fixed electrodes of the actuators,

c) assembly of two substrates with the recessed part facing the etched surface layer,

d) etching of the outline of the moving electrodes, of a second region of the moving part, a second region of the means of connection and of a second region of the drive arms, in the intermediate layer and prior metallization electrically connected to moving electrodes for the application of the actuation voltage of each actuator via the fixed part and the moving part.

24. Process according to claim 23, wherein trenches of insulation are made during step

a) in the surface layer and in the upper insulation layer at the first region of the fixed part and the first region of the moving part and in the intermediate layer during step d) at the moving electrodes and the second region of the moving part to provide electrical insulation of the moving electrodes during the application of actuation voltage to a

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moving electrode via the first region of the fixed part and the first region of the moving part.

25. Process according to claim 23, wherein step b) includes the etching of the cavity in a central part of the recessed part.

26. Process according to claim 23, wherein step b) is followed by a step for the creation of a layer of insulating material on the second etched substrate.

27. Process according to claim 23, wherein the second region of the moving part forms the reflective zone.

28. Process according to claim 23, wherein it includes a step for metallization of the second region of the moving part in order to form the reflective zone.

29. Process according to claim 23, wherein, after assembly, the second insulating layer is removed.

30. Process according to claim 23, wherein the surface layer is thicker than the intermediate layer.

31. Process according to claim 23, wherein the first substrate is a double SOI substrate and includes next to the second insulating layer a semi-conductive base layer which is removed after assembly of the two substrates.

32. Micro-lens made up of a moving part, with a refringent zone, a fixed part, a means of connection of the moving part to the fixed part, forming an axis of rotation contained in the moving part and means of electrical control of the rotation of the moving part about the axis, wherein the means of electrical control include two or more actuators, each formed of a fixed electrode which forms part of the fixed part and a moving

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electrode possessing a free end and an end which is connected to a drive arm which is substantially parallel to the axis and emerging from the moving part, with the moving electrode being designed to adhere to the fixed electrode from its free end when an actuation voltage is applied between the electrodes of one of the actuators, the adhesion occurring over a surface which varies as a function of the voltage applied between the electrodes of the actuator, with the actuators being arranged on either side of the axis.

33. Micro-lens according to claim 32, wherein the means of connection of the moving part to the fixed part are two torsion arms emerging from the moving part whose ends are connected to the fixed part.

34. Micro-lens according to claim 32, wherein the axis passes through the geometric center of the moving part.

35. Micro-lens according to claim 33, wherein, on the same side of the moving part, a drive arm is offset in relation to a torsion arm.

36. Micro-lens according to claim 33, wherein, on the same side of the moving part, a drive arm and a torsion arm form an extension of each other.

37. Micro-lens according to claim 36, wherein the torsion arm has a transverse section that is less than that of the drive arm.

38. Micro-lens according to claim 36, wherein the torsion arm has a transverse section that is substantially equal to that of the drive arm.

39. Micro-lens according to claim 32, wherein several moving electrodes are linked to the same drive arm.

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40. Micro-lens according to claim 32, wherein each drive arm is integral with a single moving electrode.

41. Micro-lens according to claim 32, wherein several moving electrodes located on the same side of the axis are linked together at their free end.

42. Micro-lens according to claim 32, wherein at least one moving electrode is wound on itself, with its free end located in a central area of the winding.

43. Micro-lens according to claim 32, wherein at least one moving electrode is substantially rectilinear.

44. Micro-lens according to claim 32, wherein at least one moving electrode includes a body of substantially constant width extending by means of a stub at its free end, the width of the stub being greater than that of the body.

45. Micro-lens according to claim 32, wherein the fixed electrodes of the actuators are combined.

46. Micro-lens according to claim 32, wherein the fixed part includes a base and columns on which the means of connection rest, with the moving part being suspended above the base.

47. Micro-lens according to claim 46, wherein the base includes a cavity opposite the moving part which is suspended above the cavity.

48. Micro-lens according to claim 32, wherein the fixed electrodes are covered with a dielectric material.

49. Micro-lens according to claim 32, wherein the means of electrical control include an addressing device capable of applying an actuation voltage to the moving electrodes

and/or the fixed electrodes.

50. Micro-lens according to claim 49, wherein the actuation voltage is a continuous voltage added to a variable control voltage.

51. Micro-lens according to claim 49, wherein at least one fixed electrode of an actuator is divided into two portions one of which is an end portion, with these two portions being insulated from each other, with the addressing device being capable of applying a continuous voltage to the end portion and a variable control voltage to the other portion.

52. Micro-lens according to claim 50, wherein the continuous voltage is a minimal voltage for maintaining adhesion of the free end of the moving electrode of the actuator onto the fixed electrode.

53. Micro-lens according to claim 50, wherein, when the control voltage applied to an actuator located on one side of the axis is non-zero, the control voltage applied at the same time to an actuator located on the other side of the axis is zero.

54. Process for the manufacture of a micro-lens according to claim 32, wherein it includes the following steps:

a) etching of the outline of a first region of the moving part, of a first region of the fixed part, of a first region of the drive arms and of a first region of the means of connection in a surface layer and a first insulating layer of a stratified substrate made up of an alternating stacking of a first and second layer of insulating material and two semi-conductive layers one of which is intermediate and the other of which is a surface layer,

b) in a second semi-conductive substrate the etching of a recessed part, with this second substrate helping to form a second region of the fixed part and the fixed electrodes of the actuators,

c) assembly of two substrates with the recessed part facing the etched surface layer,

d) etching of the outline of the moving electrodes, of a second region of the moving part, a second region of the means of connection and of a second region of the drive arms, in the intermediate layer and prior metallization electrically connected to moving electrodes for the application of the actuation voltage of each actuator via the fixed part and the moving part.

55. Process according to claim 54, wherein trenches of insulation are made during step a) in the surface layer and in the upper insulation layer at the first region of the fixed part and the first region of the moving part and in the intermediate layer during step d) at the moving electrodes and of the second region of the moving part to provide electrical insulation of the moving electrodes during the application of actuation voltage to a moving electrode via the first region of the fixed part and the first region of the moving part .

56. Process according to claim 54, wherein step b) includes the etching of the means forming the pivot in the recessed part.

57. Process according to claim 54, wherein step b) includes the etching of the cavity in a central part of the recessed part.

58. Process according to claim 54, wherein step b) is followed by a step for the creation

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of a layer of insulating material on the second etched substrate.

59. Process according to claim 54, wherein the moving part is etched in the form of a frame during step b).

60. Process according to claim 59, wherein it includes a step for assembly of a lenticular refringent element to the frame of the moving part in order to form the refringent zone.

61. Process according to claim 54, wherein, after assembly in step c), the second insulating layer is removed.

62. Process according to claim 54, wherein the surface layer is thicker than the intermediate layer.

63. Process according to claim 54, wherein the first substrate is a double SOI substrate and includes next to the second insulating layer a semi-conductive base layer which is removed after assembly of the two substrates.

All claims pending thus being allowable, prosecution on the merits is closed in this application. A statement of the examiner's reasons for allowance is provided in the paragraphs, which follow below.

REASONS FOR ALLOWANCE

Claims 1-63 are allowed.

The instant application is deemed to be directed to a nonobvious improvement over the invention of Ruan et al (US 6,633,212 B1) as being a representative example in the art to which the instant invention pertains. In particular, the primary reason for allowance is directed to said micro-mirror/lens comprising a moving electrode being designed to adhere to a fixed electrode from its free end when an actuation voltage is applied between two electrodes of an actuator, the adhesion occurring over a surface which varies as a function of the voltage applied (Claim 1, lines 13-18 and Claim 32, lines 12-18), which in the examiner's opinion, would not have been obvious to one of ordinary skill in the art.

The prior art taken either singly or in combination fails to anticipate or fairly suggest the limitations of applicant's independent claims, in such a manner that a rejection under 35 U.S.C. 102 or 103 would be proper. The claimed invention is therefore considered to be in condition for allowance as being novel and nonobvious over prior art.

OTHER REMARKS/INFORMATION

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William C. Choi whose telephone number is (571) 272-2324. The examiner can normally be reached on Monday-Friday from about 9:00 am to 6 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ricky Mack can be reached on (571) 272-2333. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/William C. Choi/
Primary Examiner, Art Unit 2873
March 24, 2008